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AF/ 2626 #22 5/7/04

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

David M. Emerling, et al.

Serial No.: 09/382,851

Filed: August 25, 1999

Group Art Unit: 2643

Examiner: Lao, Lun S.

For: VEHICULAR AUDIO SYSTEM AND ELECTROMAGNETIC TRANSDUCER ASSEMBLY FOR USE THEREIN

Attorney Docket No.: LDOS 0230 PUS

APPEAL BRIEF

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Sir:

This is an appeal brief from the final rejection of claims 1-41, 43 and 44 of the Office Action dated November 28, 2003. This application was filed on August 25, 1999.

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I. REAL PARTY IN INTEREST

The real party in interest is Lear Corporation, a corporation organized and existing under the laws of the state of Delaware, and having a place of business at 21557 Telegraph Road, Southfield, Michigan 48034, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on November 12, 1999 at Reel 010381/Frame 0404.

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I hereby certify that this paper, including all enclosures referred to herein, is being deposited with the United States Postal Service as first-class mail, postage pre-paid, in an envelope addressed to: Mail Stop Appeal Brief - Patents, Commissioner for Patents, U.S. Patent & Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 on:

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II. RELATED APPEALS AND INTERFERENCES

Concurrent with the present appeal, an appeal has been filed to U.S. Application No. 10/049,993, filed April 2, 2002 and titled "VEHICULAR AUDIO SYSTEM INCLUDING A HEADLINER SPEAKER, ELECTROMAGNETIC TRANSDUCER ASSEMBLY FOR USE THEREIN AND COMPUTER SYSTEM PROGRAMMED WITH A GRAPHIC SOFTWARE CONTROL FOR CHANGING THE AUDIO SYSTEM'S SIGNAL LEVEL AND DELAY" which is a continuation-in-part of the present application, and is under final rejection issued by the same Examiner as the present application.

III. STATUS OF CLAIMS

Claims 1- 44 are pending in this application. Claim 42 has been withdrawn in response to a restriction requirement issued September 30, 2002. Claims 1-41, 43 and 44 have been rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

An amendment to the non-final rejection dated June 19, 2003 was filed on August 21, 2003. A response to non-compliant amendment under 37 C.F.R. § 1.121 was filed on September 19, 2003 and has been accepted for entry. There are no amendments pending in the present application.

V. SUMMARY OF THE INVENTION

In a first embodiment, the present invention provides an audio system for use in a vehicle (16) having a roof. The system comprises an acoustically-insulating headliner (11), a source of audio signals (15), an array of electromagnetic transducer assemblies (12), and signal processing circuitry (17). The acoustically-insulating headliner is adapted to be mounted adjacent the roof so as to underlie the roof and shield the roof from view. The headliner has an upper surface and a sound-radiating, lower surface. The array of electromagnetic transducer assemblies is supported at the upper surface of the headliner. The

signal processing circuitry is coupled to the assemblies for processing the audio signals to obtain processed audio signals. The assemblies generally convert the processed audio signals into mechanical motion of corresponding zones of the headliner. The headliner is generally made of a material which is sufficiently stiff and low in density so that substantially the entire headliner acts as a single headliner speaker diaphragm and radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more. The processed audio signals at a low end of the frequency range are generally matched to the processed audio signals at mid and high ends of the frequency range. (See, for example, Figure 1, and the specification on page 10, l. 20 through page 11, l. 17, page 14, l. 5-28, and page 15, ll. 1-12).

In a second embodiment, the present invention provides an audio system for use in a vehicle (16) having a roof. The system comprises an acoustically-insulating headliner (11), a source of audio signals (15), an array of electromagnetic transducer assemblies (12), and signal processing circuitry (17). The acoustically-insulating headliner is adapted to be mounted adjacent the roof so as to underlie the roof and shield the roof from view. The headliner has an upper surface and a sound-radiating, lower surface. The array of electromagnetic transducer assemblies is supported at the upper surface of the headliner. The signal processing circuitry is generally coupled to the assemblies for processing the audio signals to obtain processed audio signals. The assemblies generally convert the processed audio signals into mechanical motion of corresponding zones of the headliner. The headliner is generally made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more. The processed audio signals at a low end of the frequency range are generally matched to the processed audio signals at mid and high ends of the frequency range. The headliner material generally has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per

meter cubed. (See, for example, Figure 1, and the specification on page 6, ll. 23-24, page 10, l. 20 through page 11, l. 17, page 14, l. 5-28, and page 15, ll. 1-12).

In a third embodiment, the present invention provides an audio system for use in a vehicle (16) having a roof. The system comprises an acoustically-insulating headliner (11), a source of audio signals (15), an array of electromagnetic transducer assemblies (12), and signal processing circuitry (17). The acoustically-insulating headliner is adapted to be mounted adjacent the roof so as to underlie the roof and shield the roof from view. The headliner has an upper surface and a sound-radiating, lower surface. The array of electromagnetic transducer assemblies is supported at the upper surface of the headliner. The signal processing circuitry is coupled to the assemblies for processing the audio signals to obtain processed audio signals. The assemblies generally convert the processed audio signals into mechanical motion of corresponding zones of the headliner. The headliner is generally made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more. The processed audio signals at a low end of the frequency range are generally matched to the processed audio signals at mid and high ends of the frequency range. The headliner material has a stiffness (modulus of elasticity, Youngs modulus) between 1E9 Pa and 5e9 Pa and a density between 100 and 800 Kg/m^3. The headliner material may be made from single materials or composites. (See, for example, Figure 1, and the specification on page 6, ll. 23-24, page 10, l. 20 through page 11, l. 17, page 14, l. 5-28, and page 15, ll. 1-12).

VI. ISSUES

1. Claims 1, 9-11, 13, 15, 16, 35-38, 40 and 41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,356,641 to Warnaka, et al. (hereinafter Warnaka) in view of U.S. Patent No. 5,754,664 to Clark, et al. (hereinafter Clark). The first issue is whether the Examiner has made a *prima facie* case that claims 1, 9-

11, 13, 15, 16, 35-38, 40 and 41are unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark.

2. Claims 2-4, 14 and 17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Warnaka in view of Clark, and further in view of U.S. Patent No. 5,887,071 to House (hereinafter House). The second issue is whether the Examiner has made a *prima facie* case that claims 2-4, 14 and 17 are unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark, and further in view of House.

3. Claims 5-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Warnaka in view of Clark, and further in view of U.S. Patent No. 4,385,210 to Marquiss (hereinafter Marquiss). The third issue is whether the Examiner has made a *prima facie* case that claims 5-8 are unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark, and further in view of Marquiss.

4. Claims 18-23 and 25-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Warnaka in view of Clark, and further in view of international application WO99/11490 to Azima (hereinafter Azima). The fourth issue is whether the Examiner has made a *prima facie* case that claims 18-23 and 25-34 are unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark, and further in view of Azima.

5. Claim 39 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Warnaka in view of Clark, and further in view of U.S. Patent No. 5,450,057 to Watanabe (hereinafter Watanabe). The fifth issue is whether the Examiner has made a *prima facie* case that claim 39 is unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark, and further in view of Watanabe.

6. Claims 12, 24, 43 and 44 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Warnaka in view of Clark, and further in view of U.S. Patent No. 6,337,355 to Yamashita (hereinafter Yamashita). The sixth issue is whether the Examiner has made a *prima facie* case that claims 12, 24, 43 and 44 are unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark, and further in view of Yamashita.

VII. GROUPING OF CLAIMS

Applicants contend that the claims do not stand or fall together. In particular, applicants contend the claims should be grouped as follows:

1. Claims 1-11, 13-23 and 25-41 (Group I) stand or fall together.
2. Claims 12, 24, 43 and 44 (Group II) stand or fall together.

The claims in each of the Groups I and II are believed to be separately patentable over the cited art. Group I provides an acoustically-insulating headliner having an upper surface and a sound-radiating, lower surface. An array of electromagnetic transducer assemblies may be supported at the upper surface of the headliner. The assemblies generally convert the processed audio signals into mechanical motion of corresponding zones of the headliner. The headliner is generally made of a material which is sufficiently stiff and low in density so that substantially the entire headliner acts as a single headliner speaker diaphragm and radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more.

In Group II claims 12 and 24 provide the limitations of claim 1 and additionally, the headliner material has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per meter cubed (claims 12 and 24), and the headliner material may be made from single materials or composites (claim 24). Claims 43 and 44 provide limitations

similar to claim 1 and additionally, the headliner material has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per meter cubed (claims 43 and 44), and the headliner material may be made from single materials or composites (claim 44). Group II is believed to be separably patentable over Group I because Group II claims further limitations to the headliner material.

VIII. ARGUMENT

1. The Examiner has Failed to Make a *Prima Facie* Case that Group I is Unpatentable under 35 U.S.C. §103(a)

A *prima facie* case of obviousness requires three basic criteria:

> First, there must be some suggestion of motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.
>
> The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.

(*In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)).

Furthermore, "[a] prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention." (*W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)).

Here, the Examiner has rejected claim 1 as being unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark. The Examiner has failed to establish, however, that the combination of Warnaka and Clark teach or suggest all the limitations of the Applicants' claimed invention. In particular, independent claim 1 provides an acoustically-insulating

headliner adapted to be mounted adjacent a roof, the headliner having an upper surface and a sound-radiating, lower surface, an array of electromagnetic transducer assemblies supported at the upper surface of the headliner, wherein the assemblies convert processed audio signals into mechanical motion of corresponding zones of the headliner and the headliner is made of a material which is sufficiently stiff and low in density so that substantially the entire headliner acts as a single headliner speaker diaphragm and radiates acoustic power into the interior of the vehicle.

The Examiner contends that Warnaka teaches an array of electromagnetic transducers. (See, final Office Action dated November 28, 2003 at page 2, ll. 15-22). However, the Examiner has mis-characterized Warnaka. In particular, Warnaka teaches transducers (15), which are flat piezoelectric elements. (Warnaka, col. 5, ll. 16-19). One of ordinary skill in the art would understand that piezoelectric elements may be defined as transducers that depend for their operation on the interaction between the electric charge and the deformation of certain assymetric crystals having piezoelectric properties. (See, for example, Graf, Rudolf, Modern Dictionary of Electronics, 1997, page 748, a copy of which is attached for the Examiner's convenience). In contrast, claim 1 provides for an array of electromagnetic transducers. As such, the Examiner's characterization of piezoelectric elements as electromagnetic transducers is clearly technically inaccurate.

Furthermore, the use of piezoelectric elements for driving portions of interior trim was well known and fully considered by the Applicants. (See, Background of the present application, page 3, ll. 19-27. Note also, the inventor, Parrella, of the reference discussed in the Background, i.e., U.S. Patent No. 5,901,231, is a co-inventor of the Warnaka reference). As discussed in the Background of the present application, the use of piezo-electric elements restricts them to dividing up the trim into different sections for different frequency ranges adding complexity to the system. Furthermore, the excursion limits of piezo elements limits the output level and low frequency range of the trim panels such that conventional cone

speakers would be required to produce lower frequencies. The piezo elements also require complicated integration into the trim element and are difficult to service. Lastly, the piezo elements require additional circuitry to convert typical output from an automotive head unit further complicating the system. The present invention overcomes the deficiencies of the use piezoelectric elements for driving portions of interior trim as taught by Warnaka.

The Examiner further contends that [while] Warnaka discloses that piezoelectric transducers are preferred, other types transducers (such as electromagnetic transducers) may be used in the invention. (See, final Office Action dated November 28, 2003 at page 15, ll. 10-13 citing Warnaka at col. 11, ll. 15-28), but Warnaka fails to enable the other types of transducers. Clearly, the Examiner has further mis-characterized Warnaka. In particular, at the portion of Warnaka cited by the Examiner, Warnaka discusses the deficiencies of other types of transducers *vis a vis* piezoelectric transducers but nowhere does Warnaka provide disclosure of an enabled alternative embodiment of an invention that implements electromagnetic transducers. As such, Warnaka fails to teach an array of electromagnetic transducers as presently claimed.

Clark was well known and fully considered by the Applicants. (See, specification on page 2, ll. 3-9). The Examiner contends that Clark teaches a headliner that radiates acoustic power into the interior of a vehicle. (See, final Office Action dated November 28, 2003 at page 2, ll. 12-16). The Examiner also contends that Clark teaches electromagnetic transducers. (See, final Office Action dated November 28, 2003 at page 15, ll. 13-17). However, the Examiner has mis-characterized Clark. Clark teaches overhead speakers that are positioned such that they provide strong front staging and desired ambience, and that are mounted directly to a headliner. (Clark, Abstract). Nowhere does Clark disclose, teach or suggest a headliner that radiates acoustic power into the interior of a vehicle as presently claimed.

One of ordinary skill in the art would understand that a loudspeaker as taught by Clark, in contrast to the electromagnetic transducers as defined in the present invention, can be defined as a transducer that reproduces sound by responding to an electrical signal produced by an amplifier. It contains a thin but rigid cone fixed to a coil. The electrical signal goes to the coil, which sits inside a magnetic field created by a circular permanent magnet around the coil. The coil also produces its own magnetic field, which varies in strength as the varying signal passes through it. The two magnetic fields push and pull on each other, causing the coil to vibrate in step with the variations of the signal. The cone vibrates at the same frequencies as the original sound waves. (See, for example, Macaulay, David, The New Way Things Work, 1998, page 228, a copy of which is provided for the Examiner's convenience). As such, Clark fails to cure the deficiencies of Warnaka. Therefore, Warnaka and Clark, alone or in combination, fail to provide the claimed features of the present invention and the rejection should be withdrawn.

Furthermore, nowhere do Warnaka or Clark, alone or in combination, disclose, teach or suggest signal processing circuitry that is coupled to electromagnetic transducer assemblies for processing the audio signals to obtain processed audio signals where the assemblies convert the processed audio signals into mechanical motion of corresponding zones of the headliner, and the headliner is made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more. In particular, the Examiner admits that Warnaka fails to teach signal processing as presently claimed. (See, final Office Action dated November 28, 2003 at page 3, ll. 4-11). Instead, the Examiner contends that Clark teaches signal processing circuitry as presently claimed. (See, final Office Action dated November 28, 2003 at page 3, ll. 12-20).

However, the Examiner has mis-characterized Clark. In particular, Clark teaches a control circuit (16) that generates output signals driving speakers (18-29). (Clark,

Figs. 1, 3, 4 and 9, and col. 3, ll. 56 through col. 4, l. 44). Nowhere does Clark teach signal processing circuitry that is coupled to electromagnetic transducer assemblies for processing the audio signals to obtain processed audio signals where the assemblies convert the processed audio signals into mechanical motion of corresponding zones of the headliner. As such, Clark fails to cure the deficiencies of Warnaka, Warnaka and Clark, alone or in combination, fail to provide all of the features of the presently pending invention, and the rejection should be reversed.

Yet furthermore, even if the cited references, alone or in combination, resulted in the presently pending invention which Applicants do not concede is the present case, the Examiner has failed to provide the motivation to combine the teaching of Warnaka and Clark as is required for a *prima facie* case of obviousness under 35 U.S.C. § 103(a). The mere fact that references can be combined or modified, which Applicants do not agree is the case with respect to the cited references, does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination or modification. In that regard, "[a] prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention". (*W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)). "The totality of the prior art must be considered, and proceeding contrary to accepted wisdom in the art is evidence of nonobviousness". (*In re Hedges*, 783 F.2d 1038, 228 USPQ 685 (Fed. Cir. 1986)).

"Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. 'The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the

nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art.'" (*In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000)).

The headliner taught by Warnaka is implemented with piezoelectric transducers. Clark teaches implementation of conventional loudspeakers mounted to the headliner. As such, Warnaka and Clark, alone or in combination, fail to provide any suggestion or motivation for the presently claimed invention and the rejection should be reversed.

The Examiner has also used impermissible hindsight to combine the teachings of Warnaka and Clark to attempt to piece together the Applicants' invention. The teaching or suggestion to make the claimed combination must be found in the prior art, not in the applicant's disclosure. (*In re Dembiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999) ("Combining prior art references without evidence of ... suggestion, teaching, or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability–the essence of hindsight.")). The Examiner has failed to provide any motivation for any combination of art that would provide the features of the present invention. In fact, both Warnaka and Clark fail to teach the implementation of electromagnetic transducer assemblies, and a headline that is made of a material which is sufficiently stiff and low in density so that substantially the entire headliner acts as a single headliner speaker diaphragm and radiates acoustic power into the interior of the vehicle, as presently claimed.

Moreover, "[d]efining the problem in terms of its solution reveals improper hindsight in the selection of the prior art relevant to obviousness." (*Ecolochem, Inc. v. Southern Edison Co.*, 227 F.3d 1361, 1372 (Fed. Cir. 2000) (citing *Monarch Knitting Mach. Corp. v. Sulzer Morat Gmbh*, 139 F.3d 877, 880 (Fed. Cir. 1998)). Here, the references cited by the Examiner fails to recognize the problem addressed by the Applicants' claimed invention (i.e., as stated in the presently pending application on page 4, ll. 10-18, "There is still a need to reduce parts and labor cost, decrease weight, decrease exterior noise penetration, provide

believable imaging, reduce speaker visibility, increase reliability, and provide easy serviceability...using existing trim panel space and mounting techniques, conventional audio signal head unit output, advanced material properties manipulation and well established signal processing, and psychoacoustic techniques."). Warnaka concerns a headliner excited by transducers that are flat piezoelectric elements. Clark is directed to a vehicle audio system that includes overhead speakers that are direct driving speakers. As such, Warnaka and Clark, alone or in combination, fail to teach the invention as presently claimed. As such, the Examiner has failed to make a *prima facie* case of obviousness as is required under 35 U.S.C. § 103 and the rejection should be reversed.

Regarding the claims which depend from claim 1, Applicants contend that these claims are patentable for at least the same reasons that claim 1 is patentable. Moreover, Applicants contend that these claims recite further limitations, in addition to the limitations of claim 1, which render these claims additionally patentable. In particular, claim 5 provides the limitations of claim 1 and further provides each of the electromagnetic transducer assemblies includes a magnet for establishing a magnetic field in a gap formed within the assembly, a coil which moves relative to the magnet in response to the processed audio signals, a base fixedly secured to the headliner on the upper surface and electrically connected to the signal processing circuitry and a guide member electrically connected to the coil and removably secured to the base for supporting the coil in the gap and wherein the coils are electrically coupled to the signal processing circuit when the guide members are secured to their corresponding bases.

The Examiner has rejected claim 5 as being unpatentable under 35 U.S.C. § 103(a) over Warnaka in view of Clark and further in view of Marquiss. However, Marquiss teaches an electro-acoustic transducer using a segmented planar diaphragm. (Marquiss, col. 2, l. 56 through col. 3, l. 0). Marquiss fails to disclose, teach or suggest electromagnetic transducer assemblies that convert the processed audio signals into mechanical motion of corresponding zones of the headliner, and the headliner is made of a material which is

sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more, as presently claimed. As such, Marquiss fails to cure the deficiencies of Warnaka and Clark and the rejection should be reversed.

2. **The Examiner has Failed to Make a *Prima Facie* Case that Group II is Unpatentable under 35 U.S.C. §103(a)**

A *prima facie* case of obviousness requires three basic criteria:

> First, there must be some suggestion of motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.
>
> The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.

(*In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)).

Furthermore, "[a] prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention." (*W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)).

Claims 12 and 24 depend from claim 1 and, as such, provide the limitations of claim 1. Claims 12 and 24 further provide the headliner material has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per meter cubed. Claim 24 additionally provides the headliner may be made from single materials or composites.

Independent claims 43 and 44 provide similar recitations to independent claim 1. In particular, independent claims 43 and 44 provide an acoustically-insulating headliner adapted to be mounted adjacent a roof, the headliner having an upper surface and a sound-radiating, lower surface, an array of electromagnetic transducer assemblies supported at the upper surface of the headliner, wherein the assemblies convert processed audio signals into mechanical motion of corresponding zones of the headliner, the headliner is made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle, and the headliner material has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per meter cubed. Claim 44 additionally provides the headliner material may be made from single materials or composites.

The Examiner has failed to establish that the combination of Warnaka, Clark, and Yamashita teaches or suggests all the limitations of the Applicants' claimed invention. In particular, as argued above in connection with Group I and incorporated in the entirety, Warnaka and Clark, alone or in combination, fail to provide an acoustically-insulating headliner adapted to be mounted adjacent a roof, the headliner having an upper surface and a sound-radiating, lower surface, an array of electromagnetic transducer assemblies supported at the upper surface of the headliner, wherein the assemblies convert processed audio signals into mechanical motion of corresponding zones of the headliner, and the headliner is made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle, as provided in claims 1, 43 and 44.

The Examiner further contends that Yamashita teaches a headliner material (urethane foam) that has a stiffness inherently between 1GPa and 5GPa and a density between 100 and 800 Kg/m^3 and the headliner may be made from single materials or composites. (See, final Office Action dated November 28, 2003 at page 14, ll. 19-22). However, the Examiner has mis-characterized the teaching of Yamashita.

In particular, Yamashita teaches injecting expandable or foaming two-pack urethane material in a closed sectional structure of a body for reinforcing the closed structure. (Yamashita, col. 1, ll. 5-10). Yamashita teaches improved mechanical strength (e.g., bending performance) for a vehicle body member, specifically a frame, into which a two-pack urethane foam material has been injected. (Yamashita, col. 16, l. 50 through col. 18, l.8). Nowhere does Yamashita teach, disclose or suggest a urethane foam headliner material that has a stiffness inherently between 1GPa and 5GPa and a density between 100 and 800 Kg/m^3 (claims 12, 24, 43 and 44), and the headliner is made from single materials or composites (claims 24 and 44). As such, the combination of Warnaka, Clark and Yamashita fails to disclose, teach or suggest the features of presently pending claims 12, 24, 43 and 44 and the rejection should be reversed.

The Examiner contends that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the urethane foam as taught by Yamashita as the headliner material in the system of Warnaka as modified by Clark to provide accurate filling and reduced non-filled sites in a mass produced environment. (See final Office Action dated November 28, 2003 at page 15, ll. 1-5). However, to rely on a reference under 35 U.S.C. §103(a), it must be analogous prior art. "[T]he reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the invention was concerned." (*In re Oetiker*, 977 F.2d 1443, 1446, (Fed. Cir. 1992)). In the present case, nowhere do Warnaka or Clark disclose, teach or suggest a headliner formed by filling or injecting foam into a closed structure as is taught by Yamashita. As such, the Examiner has failed to make a *prima facie* case of obviousness as is required under 35 U.S.C. § 103 and the rejection should be reversed.

IX. CONCLUSION

The Examiner rejected as being unpatentable under 35 U.S.C. § 103(a) claims 1, 9-11, 13, 15, 16, 35-38, 40 and 41 over Warnaka in view of Clark, claims 2-4, 14 and 17

over Warnaka in view of Clark, and further in view of House, claims 5-8 over Warnaka in view of Clark, and further in view of Marquiss, claims 18-23 and 25-34 over Warnaka in view of Clark, and further in view of Azima, claim 39 over Warnaka in view of Clark, and further in view of Watanabe, and claims 12, 24, 43 and 44 over Warnaka in view of Clark, and further in view of Yamashita. However, the Examiner has failed to establish a *prima facie* case of obviousness under 35 U.S.C. §103(a). In particular, the references cited by the Examiner, alone or in combination, fail to teach or suggest all the elements of the presently pending independent claim 1. Dependent claims 2-41 are patentable for at least the same reasons that claim 1 is patentable.

Furthermore, Warnaka, Clark, and Yamashita, alone or in combination, fail to teach or suggest all the elements of the presently pending dependent claims 12 and 24, and independent claims 43 and 44. In addition, the Examiner has failed to show a proper suggestion or motivation for combining the references. Therefore, the final rejection of claims 1-41, 43 and 44 should be reversed.

The fee of $330 as applicable under the provisions of 37 C.F.R. § 1.17(c) is enclosed. Please charge any additional fee or credit any overpayment in connection with this filing to our Deposit Account No. 02-3978. A duplicate of this notice is enclosed for this purpose.

Respectfully submitted,

David M. Emerling, et al.

By: _____

Thomas W. Saur
Registration No. 45,075
Attorney/Agent for Applicant

Date: April 21, 2004

BROOKS KUSHMAN P.C.
1000 Town Center, 22nd Floor
Southfield, MI 48075-1238
Phone: 248-358-4400
Fax: 248-358-3351

Enclosures - Appendix, Claims on Appeal
Graf, Rudolf, Modern Dictionary of Electronics, 1997, page 748
Macaulay, David, The New Way Things Work, 1998, page 228

IX. APPENDIX - CLAIMS ON APPEAL

1. An audio system for use in a vehicle having a roof, the system comprising:

an acoustically-insulating headliner adapted to be mounted adjacent the roof so as to underlie the roof and shield the roof from view, the headliner having an upper surface and a sound-radiating, lower surface;

a source of audio signals;

an array of electromagnetic transducer assemblies supported at the upper surface of the headliner;

signal processing circuitry coupled to the assemblies for processing the audio signals to obtain processed audio signals wherein the assemblies convert the processed audio signals into mechanical motion of corresponding zones of the headliner and wherein the headliner is made of a material which is sufficiently stiff and low in density so that substantially the entire headliner acts as a single headliner speaker diaphragm and radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more and the processed audio signals at a low end of the frequency range are matched to the processed audio signals at mid and high ends of the frequency range.

2. The system as claimed in claim 1 wherein the vehicle has a windshield and wherein the array of electromagnetic transducer assemblies includes at least one row of electromagnetic transducer assemblies adjacent the windshield and wherein the at least one row of electromagnetic transducer assemblies are positioned 5 to 30 inches in front of an expected position of a passenger in the interior of the vehicle.

3. The system as claimed in claim 2 wherein the at least one row of electromagnetic transducer assemblies are positioned 12 to 24 inches in front of the expected position of the passenger.

4. The system as claimed in claim 2 wherein the at least one row of electromagnetic transducer assemblies includes at least two electromagnetic transducer assemblies spaced apart to correspond to left and right ears of the passenger in the expected position of the passenger.

5. The system as claimed in claim 1 wherein each of the electromagnetic transducer assemblies includes a magnet for establishing a magnetic field in a gap formed within the assembly, a coil which moves relative to the magnet in response to the processed audio signals, a base fixedly secured to the headliner on the upper surface and electrically connected to the signal processing circuitry and a guide member electrically connected to the coil and removably secured to the base for supporting the coil in the gap and wherein the coils are electrically coupled to the signal processing circuit when the guide members are secured to their corresponding bases.

6. The system as claimed in claim 5 wherein each of the magnets is a high-energy permanent magnet.

7. The system as claimed in claim 6 wherein each of the high-energy permanent magnets is a rare-earth magnet.

8. The system as claimed in claim 5 wherein each of the assemblies includes a spring element having a resonant frequency below the lower limit of the frequency range when incorporated within its assembly and connected to its corresponding guide member for resiliently supporting its corresponding magnet above the upper surface of the headliner.

9. The system as claimed in claim 1 wherein the array of electromagnetic transducer assemblies includes a front row of electromagnetic transducer assemblies positioned 5 to 30 inches in front of an expected position of a passenger in the interior of the vehicle and a back row of electromagnetic transducer assemblies positioned behind the expected position of the passenger wherein the signal processing circuitry delays the audio signals coupled to the back row of electromagnetic transducer assemblies relative to the audio signals coupled to the front row of electromagnetic transducer assemblies.

10. The system as claimed in claim 1 wherein the array of electromagnetic transducer assemblies are completely supported on the upper surface of the headliner.

11. The system as claimed in claim 1 further comprising at least one loudspeaker coupled to the signal processing circuitry, and adapted to be placed in the interior of the vehicle in front of an expected position of a passenger and below the headliner.

12. The system as claimed in claim 1 wherein the headliner material has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per meter cubed.

13. The system as claimed in claim 1 wherein the electromagnetic transducer assemblies are spaced to the left and right, front and rear of expected positions of passengers in the interior of the vehicle to create proper audio imaging for the passengers.

14. The system as claimed in claim 1 further comprising at least one loudspeaker positioned in front of expected positions of passengers below the headliner but not in doors, kick panels, or under a dash of the vehicle.

15. The system as claimed in claim 1 further comprising a low frequency speaker positioned below the headliner in the interior of the vehicle.

16. The system as claimed in claim 1 wherein the array has front and rear assemblies and wherein each rear electromagnetic transducer assembly is coupled to processed audio signals delayed in time relative to the processed audio signals coupled to each front electromagnetic transducer assembly.

17. The system as claimed in claim 1 wherein the audio signals are processed with head-related transfer functions by the signal processing circuitry.

18. The system as claimed in claim 1 wherein the electromagnetic transducer assemblies are supported only on the headliner.

19. The system as claimed in claim 1 wherein the headliner is self-supporting.

20. The system as claimed in claim 1 further comprising a semi-compliant attachment mechanism adapted to attach the headliner to the roof along at least a substantial periphery of the roof.

21. The system as claimed in claim 1 further comprising a semi-compliant attachment mechanism adapted to attach the headliner to the roof along at least a substantial periphery of the roof and a central portion of the roof.

22. The system as claimed in claim 1 further comprising a support structure for reinforcing the headliner.

23. The system as claimed in claim 1 further comprising framing independent of the headliner to support the assemblies.

24. The system as claimed in claim 1 wherein the headliner material has a stiffness (modulus of elasticity, Youngs modulus) between 1E9 Pa and 5e9 Pa and a density between 100 and 800 Kg/m^3 and wherein the headliner material may be made from single materials or composites.

25. The system as claimed in claim 1 wherein stiffness and density of the headliner material is altered around the entire periphery of the headliner to allow for additional excursion of the entire headliner in order to create better low frequency reproduction (<200 Hz) of the processed audio signals.

26. The system as claimed in claim 1 further comprising a fabric or other material adhered to the lower surface of the headliner to create a cosmetically acceptable appearance for the system.

27. The system as claimed in claim 1 further comprising a fabric or other material adhered to the upper surface of the headliner for routing wires over the headliner in order to keep the wires from vibrating when in contact with a vibrating headliner.

28. The system as claimed in claim 1 further comprising audio signal wires integrated into the headliner.

29. The system as claimed in claim 1 further comprising a material adhered to the headliner to provide additional mass or damping or stiffness thereby minimizing unwanted excess vibration caused by any resonances in the headliner material.

30. The system as claimed in claim 1 further comprising fiberglass or other suitable material positioned between the headliner and the roof to minimize undesirable acoustical reflections from the roof, to minimize standing waves set up in a cavity created between the headliner and the roof and to prevent the array of electromagnetic transducer assemblies from engaging the roof.

31. The system as claimed in claim 1 wherein a electromagnetic transducer assembly for a local sound zone is located between 5" and 30" in front of an expected ear location for a passenger.

32. The system as claimed in claim 1 wherein at least one of the electromagnetic transducer assemblies is adhered directly to the headliner.

33. The system as claimed in claim 1 wherein each of the electromagnetic transducer assemblies includes a subassembly having vibrational characteristics and adapted to be screwed, snapped, or twisted into position at the upper surface of the headliner, and wherein vibrational characteristics of each of the subassemblies can be tested for performance and quality prior to its installation on the headliner.

34. The system as claimed in claim 33 wherein each of the assemblies includes a base fixedly secured to the headliner and removably secured to its corresponding subassembly by a mechanical attachment and wherein the mechanical attachment also makes electrical contact between the base and its subassembly.

35. The system as claimed in claim 1 wherein the processed audio signals to be delivered to each electromagnetic transducer assembly may be routed to alternate electromagnetic transducer assemblies to achieve different imaging and performance goals, the processed audio signals being monaural, stereo, or multi-channel signals.

36. The system as claimed in claim 1 wherein an acoustical center channel signal in a multi-channel setup is achieved by sending a processed center channel signal to both left and the right channel electromagnetic transducer assemblies in a row of electromagnetic transducer assemblies and utilizing mechanical mixing of the headliner to move the headliner between the left and right channel electromagnetic transducer assemblies as a center channel speaker.

37. The system as claimed in claim 1 further comprising a compliant material positioned between the assemblies and the roof.

38. The system as claimed in claim 1 further comprising at least one microphone positioned in the interior of the vehicle for intra-cabin and extra-cabin communications.

39. The system as claimed in claim 1 wherein the processed audio signals represent global or local vehicle warnings delivered to the entire or local interior sections of the vehicle.

40. The system as claimed in claim 1 wherein the signal processing circuitry utilizes adaptive filtering techniques to perform automatic system equalization.

41. The system as claimed in claim 1 wherein each area in the interior of the vehicle can be separately equalized.

42. (withdrawn) An electromagnetic transducer assembly comprising:

a subassembly including:

a housing;

a magnet for establishing a magnetic field within the housing;

a coil which moves relative to the magnet in response to an audio signal; and

a flexible spider and a guide member for supporting the coil centrally within the magnetic field; and

a mating base piece for attaching the subassembly to a vehicle headliner wherein the subassembly is removably secured to the mating base piece by screwing, snapping or twisting.

43. An audio system for use in a vehicle having a roof, the system comprising:

an acoustically-insulating headliner adapted to be mounted adjacent the roof so as to underlie the roof and shield the roof from view, the headliner having an upper surface and a sound-radiating, lower surface;

a source of audio signals;

an array of electromagnetic transducer assemblies supported at the upper surface of the headliner;

signal processing circuitry coupled to the assemblies for processing the audio signals to obtain processed audio signals wherein the assemblies convert the processed audio signals into mechanical motion of corresponding zones of the headliner and wherein the headliner is made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more and the processed audio signals at a low end of the frequency range are matched to the processed audio signals at mid and high ends of the frequency range and wherein the headliner material has a stiffness between 1E9PA and 5E9PA and a density of between 100 and 800 kilograms per meter cubed.

44. An audio system for use in a vehicle having a roof, the system comprising:

an acoustically-insulating headliner adapted to be mounted adjacent the roof so as to underlie the roof and shield the roof from view, the headliner having an upper surface and a sound-radiating, lower surface;

a source of audio signals;

an array of electromagnetic transducer assemblies supported at the upper surface of the headliner;

signal processing circuitry coupled to the assemblies for processing the audio signals to obtain processed audio signals wherein the assemblies convert the processed audio signals into mechanical motion of corresponding zones of the headliner and wherein the headliner is made of a material which is sufficiently stiff and low in density so that the headliner radiates acoustic power into the interior of the vehicle with a frequency range defined by a lower limit of 100 hertz or less and an upper limit of 12 kilohertz or more and the processed audio signals at a low end of the frequency range are matched to the processed audio signals at mid and high ends of the frequency range and wherein the headliner material has a stiffness (modulus of elasticity, Youngs modulus) between 1E9 Pa and 5e9 Pa and a density between 100 and 800 Kg/m^3 and wherein the headliner material is made from single materials or composites.

MODERN DICTIONARY of ELECTRONICS

SIXTH EDITION

REVISED AND UPDATED

Rudolf F. Graf

Newnes
Boston Oxford Johannesburg Melbourne New Delhi Singapore

Newnes is an imprint of Butterworth-Heinemann

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Library of Congress Cataloging-in-Publication Data
Graf, Rudolf F.
Modern dictionary of electronics / by Rudolf F. Graf. — 6th ed.
p. cm.
Reprint. Originally published: Indianapolis, Ind. : H.W. Sams,
© 1984.
ISBN 0-7506-9870-5
1. Electronics—Dictionaries.
TK7804.G67 1996 96-25894
621.381'03—dc 20 CIP

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

The publisher offers special discounts on bulk orders of this book.
For information, please contact:
Manager of Special Sales
Butterworth–Heinemann
313 Washington Street
Newton, MA 02158–1626
Tel: 617-928-2500
Fax: 617-928-2620

For information on all Newnes electronics publications available, contact
our World Wide Web home page at: http://www.bh.com/bh

Edited by: *Charlie Buffington* and *Jack Davis*
Illustrated by: *T.R. Emrick*

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1

opposite polarity on pairs of the crystal face. The charges are proportional to the pressure, and disappear when the pressure is removed.

piezoelectricity — The phenomenon whereby certain crystalline substances, such as barium titanate, generate electrical charges when subjected to mechanical deformation. The effect was first noticed by the Curie brothers in the 1880s as a result of extensive study of the symmetry of crystalline materials. The reverse effect also occurs.

piezoelectric loudspeaker—*See* Crystal Loudspeaker.

piezoelectric material — A material which generates an electrical output when subjected to a mechanical stress. (The word is derived from the Greek *piezein,* meaning to squeeze or press.)

piezoelectric microphone—*See* Crystal Microphone.

piezoelectric oscillator — A crystal-oscillator circuit in which the frequency is controlled by a quartz crystal. *Also see* Pierce Oscillator.

piezoelectric pickup—1. A type of cartridge whose generating element is a ceramic, crystal, or electret which generates electricity when bent, twisted, or stressed. The output of such cartridges can be fairly high. It is also proportional to the amplitude of the stylus motion, rather than stylus velocity, and so requires no equalization. Both these factors allow the use of simpler input circuits, one reason why piezoelectric (chiefly ceramic) cartridges are used in low-cost equipment. 2. *See* Crystal Pickup.

piezoelectric pressure gage—An apparatus for measuring or recording very high pressures. The pressure is applied to quartz discs or other piezoelectric crystals. The resultant voltage, after amplification, is then measured or is recorded with an oscillograph.

piezoelectric speaker — *See* Crystal Speaker.

piezoelectric transducer — Also called ceramic or crystal transducer. A transducer that depends for its operation on the interaction between the electric charge and the deformation of certain asymmetric crystals having piezoelectric properties.

piezoelectric transduction — The conversion of the measurand into a change in the electrostatic charge or voltage generated by mechanically stressed crystals.

piezoid—The finished crystal product. It may include the electrodes making contact with the crystal blank.

piezo-optical transducer—A structure consisting of a thin film of liquid crystal sandwiched between light polarizing filters that have received a surface lubricant. Depending on the motion, the transducer acts as highly sensitive detector by virtue of the sensitivity of the liquid crystal that is made to float by the lubricant between the plates. It produces a readily visible and colorful optical pattern that is dependent on the amount of disturbance.

piezoresistance—Resistance that changes with pressure.

piezoresistive transduction—A change in the resistance of a conductor or semiconductor caused by a change in the mechanical stress applied to it.

pig discharge—*See* Penning discharge.

piggyback—*See* Voltage Corrector.

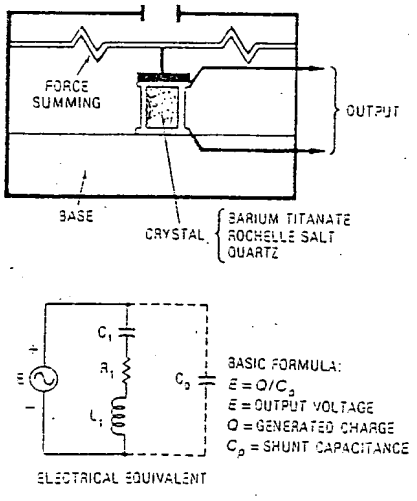
piggyback control—*See* Cascade Control.

piggyback twistor — An electrically alterable, nondestructive-readout information-storage device that consists of a thin, narrow tape of magnetic material wound spirally around a fine copper conductor. A second similar tape is wrapped on top of the first to sense the stored information. A binary digit is stored at the intersection of a copper strap and a pair of these twistor wires.

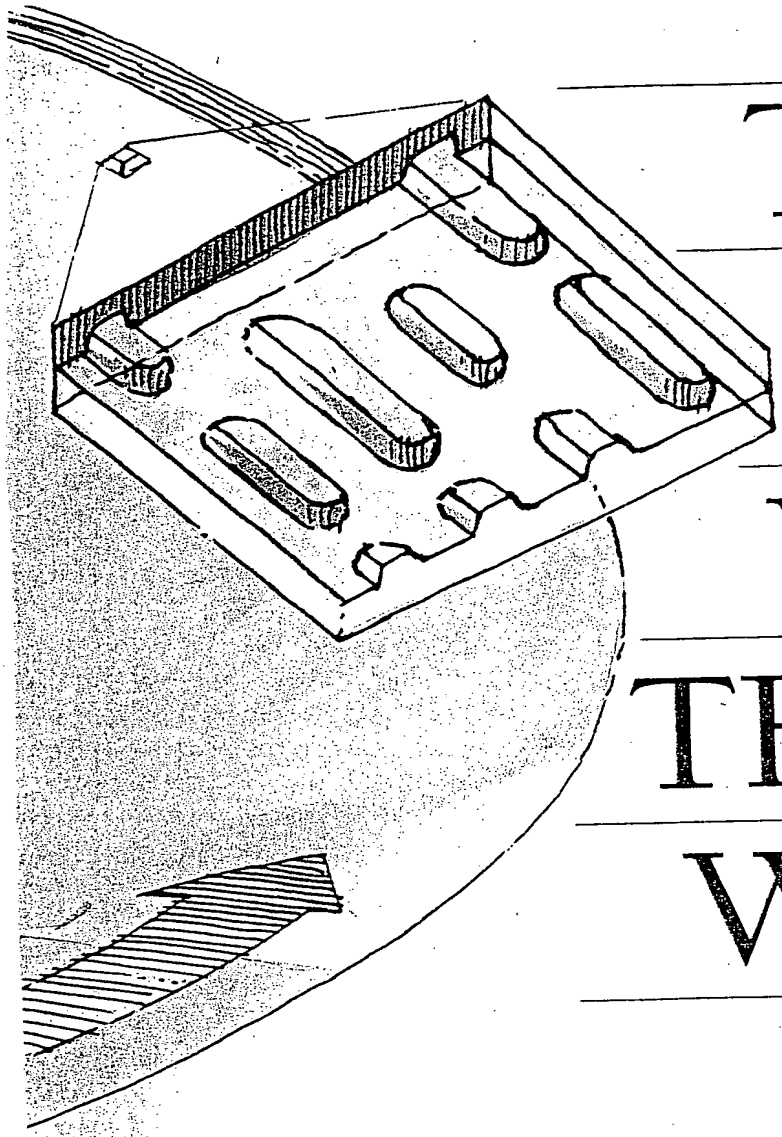
pigtail—1. Either a wire attached for terminating purposes to a shield, or a conductor extending from a small component. 2. The termination of a capacitor winding to its lead. 3. The disc-shaped head, at the end of a lead, that is attached to a capacitor winding. 4. A short wire extending from an electric or electronic device to serve as a jumper or ground connection.

pigtail splice—A splice made by tightly twisting the bared ends of parallel conductors together.

pigtail wire — Fine-stranded, extra-



Piezoelectric transducer.

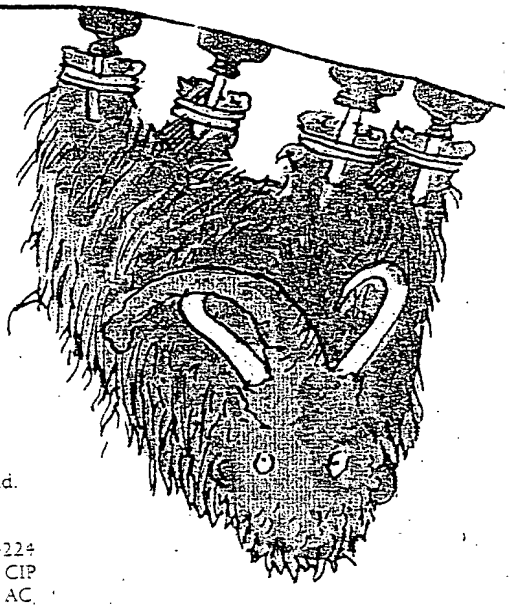


THE NEW WAY THINGS WORK

DAVID MACAULAY

WITH NEIL ARDLEY

HOUGHTON MIFFLIN COMPANY
BOSTON



A Walter Lorraine Book

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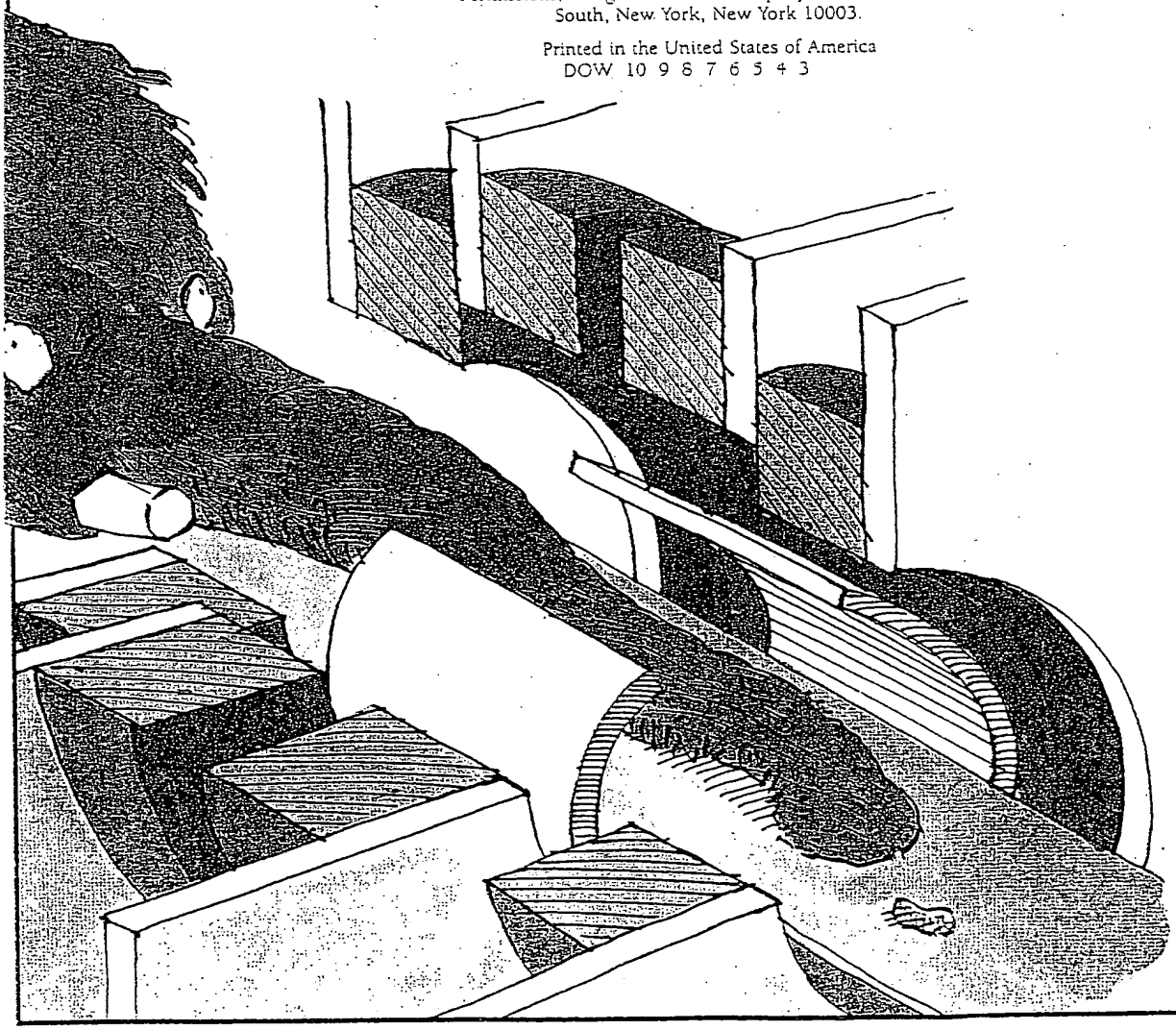
Library of Congress Cataloging-in-Publication Data

Macaulay, David.
The new way things work / written and illustrated by David Macaulay.
p. cm.
Rev. and updated ed. of: The way things work, 1988.
Summary: Text and numerous detailed illustrations introduce and explain the scientific principles and workings of hundreds of machines. Includes new material about digital technology.
ISBN 0-395-93847-3
1. Technology—Popular works. [1. Technology.] I. Macaulay, David. The Way things work. II. Title.
T47.M18 1998
600—dc21 98-14224
CIP
AC

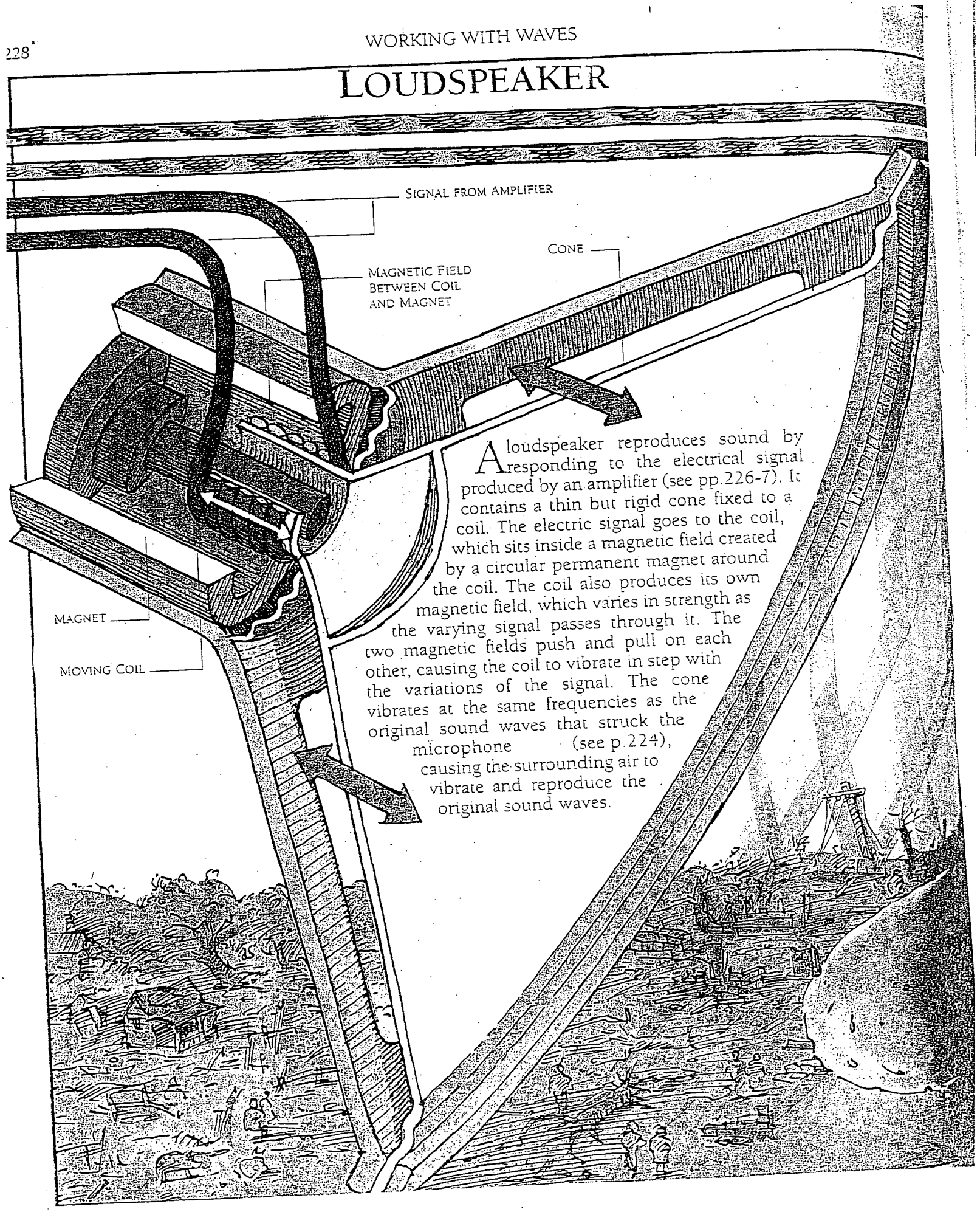
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Illustrations copyright © 1988, 1998 David Macaulay
Text copyright © 1988, 1998 David Macaulay, Neil Ardley
Originally published as *The Way Things Work*

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Printed in the United States of America
DOW 10 9 8 7 6 5 4 3



LOUDSPEAKER



A loudspeaker reproduces sound by responding to the electrical signal produced by an amplifier (see pp.226-7). It contains a thin but rigid cone fixed to a coil. The electric signal goes to the coil, which sits inside a magnetic field created by a circular permanent magnet around the coil. The coil also produces its own magnetic field, which varies in strength as the varying signal passes through it. The two magnetic fields push and pull on each other, causing the coil to vibrate in step with the variations of the signal. The cone vibrates at the same frequencies as the original sound waves that struck the microphone (see p.224), causing the surrounding air to vibrate and reproduce the original sound waves.